CLAIMS

Claim 1. A *p-n* junction electroluminescent (EL) device, comprising successive multiple layers of:

a semiconductor-on-insulator substrate;

a first p-type Si layer grown on said substrate, part of said Si layer being patterned to produce electrically isolated Si electrodes at the bottom of said device;

a thin layer of Si thinner than the substrate which allows further epitaxial growth;

a second *p*-type semiconductor layer grown epitaxially, said second layer having an energy gap larger than both said first Si layer and a pseudomorphic cladding of the quantum dot nanocrystal (CNCs) layer;

a layer comprising pseudomorphic cladded quantum dots nanocrystals (CNCs) with both cladding and core semiconductors having narrower energy gap than said second p-type layer for electroluminescence;

an n-type semiconductor layer thinner than the substrate, wider energy gap than the cladding and core layers of cladded quantum dot nanocrystals (CNCs) grown on said CNC layer; and

a metal layer forming a plurality of top contact electrodes deposited on the n-type wide energy gap semiconductor layer having patterned regions to confine current conduction in pixels of said EL device.

Claim 2. The EL device of claim 1, wherein the second p-type semiconductor layer over said CNC layer is undoped.

Claim 3. The EL device of claim 1, wherein said CNC layer is selected from the group of semiconductor materials consisting of $Zn_xCd_{1-x}Se$ (core) - $Zn_yMg_{1-y}Se$ (cladding), $Zn_xCd_{1-x}Se$ (core) - $Zn_zBe_{1-z}Se$ (cladding), $Zn_xCd_{1-x}Se$ (core) - ZnMgSSe (cladding), $In_xGa_{1-x}N$ (core) - GaN (cladding), GaN (core)-AlGaN (cladding), and ZnCdS (core)-ZnMgS (cladding), where the subscripts x, y, z represent molar fractions.

Claim 4 The EL device of claim 1, wherein said CNC layer is sandwiched between compatible wide energy gap semiconductor layers selected from the group of semiconductors consisting of $Zn_aMg_{1-a}Se$, $Zn_aMg_{1-a}S$, $Zn_aMg_{1-a}S_bSe_{1-b}$, $ZnaBe_{1-a}S_bSe_{1-b}$, $Al_cGa_{1-c}N$, and AlInN, where the subscripts a, b, c represent molar fractions.

Claim 5. The EL device of claim 1, wherein said *p-n* junction is reverse-biased electrically to operate said device in avalanche mode.

Claim 6. The EL device of claim 1, wherein said *p-n* junction is forward-biased electrically to operate in injection mode.

Claim 7. The EL device of claim 1, wherein the layer comprising CNC further comprises multiple sub-layers of differing CNCs sandwiched between epitaxially grown thin film layers of undoped wide energy gap semiconductors.

Claim 8. An EL device as described in claim 2, wherein said CNC layer is replaced by a multiplicity of CNC, each sublayer with a differing core energy gap CNCs stacked to emit different colors and white light.

Claim 9. The EL device as described in claim 1, wherein said p-doped Si layer is replaced by a transparent ITO, forming the bottom electrodes.

Claim 10. The EL device as described in claim 2, wherein a multiplicity of said CNC layers are deposited to produce red, green and blue pixel elements for a display panel.

Claim 11. The EL device of claim 1, wherein the *p*-doped wide energy gap semiconductor layer underneath the said CNC layer is replaced by a dielectric layer.

Claim 12. The EL device of claim 1, wherein the wide energy gap semiconductor layer having *n*-type conductivity over the said CNC layer is replaced by a dielectric layer.

Claim 13. The electroluminescent device of claim 11, wherein the dielectric layers are selected from the group consisting of SiON, Ta_2O_5, $Ba_xSr_{1-x}TiO_3$, PLZT, $Zn_xMg_{1-x}S$, $Zn_xBe_{1-x}S$, and their combination.

Claim14. The electroluminescent device of claim 12, wherein dielectric layers are selected from the group consisting of SiON, Ta_2O_5, $Ba_xSr_{1-x}TiO_3$, PLZT, $Zn_xMg_{1-x}S$, $Zn_xBe_{1-x}S$, and their combinations.

Claim15. The device of claim 1, wherein the wide energy gap semiconductor layer having n-type conductivity over said CNC layer is replaced by a hole-blocking layer.

Claim 16. The electroluminescent device of claim 14, wherein the hole-blocking layer is selected from the group consisting Ta_2O_5, $Zn_xMg_{1-x}S$, Zn_xBe_{1-x}, and ZnMgBeSe.

Claim 17. The device of claim 1, wherein the second *p*-doped semiconductor layer underneath the said CNC layer is replaced by a hole-transporting organic semiconductor layer.

Claim 18. The electroluminescent of claim 17, wherein the hole-transporting layer is selected from the group consisting of PVK and CBP.

Claim 19. The electroluminescent device of claim 17, wherein the hole transporting layer is doped with an oxidative agent selected from the group of compounds such as Fe^{III} citrate and Fe^{III} oxidate.

Claim 20. The EL device as described in claim 19, wherein the oxidative agent is constructed with a thin shield around the oxidizing agent utilizing appropriate counter ions, chelating agents, surfactants and dentrimers.

Claim 21. The electroluminescent device of claim 17, wherein the CNC layer is merged with the hole-transporting layer.

Claim 22. The electroluminescent device of claim 17, wherein both hole-transporting layer and CNC layer is substituted by a viscous composite comprising of CNCs, hole-transporting organic semiconductors, oxidative agents, soluble salts and [lower than atmospheric vapor pressure] viscosity-modifying agents.

Claim 23.The electroluminescent device of claim 22, wherein viscous composite is contained within appropriate openings realized between spacers, which are made of hole transporting viscous composite.

Claim 24. The electroluminescent device of claim 23, wherein the holes in said spacers are filled with said viscous composite with distinct emission characteristics.

Claim 25. The EL device as described in claim 24, wherein the viscous composites are introduced by method_selected from the group consisting of screen-printing and ink-jet printing.

Claim 26. The electroluminescent (EL) device as described in claim 1, wherein *p-n* junction is replaced by an *n-p-n* junction electroluminescent device comprising successive layers_of:

a *n*-doped silicon layer on insulator substrate, comprising thin doped Si *n/n+* regions separated by insulating regions, such as SiO_2, wherein said *n+* regions are contacted to form bottom electrodes;

a thin-layer of Si allowing for further epitaxial growth;

a n^+-type Si layer, having addressing contact electrodes;

a thin (about 10 nm) SiO_2 layer is deposited, which is deposited and patterned with a pitch of about 0.1microns;

a *p*-Si layer forming nanotips ;

an *n*-type wide energy gap layer selected from a group of semiconductors consisting of $Zn_aMg_{1-a}Se$, $Zn_aMg_{1-a}S$, $Zn_aMg_{1-a}S_bSe_{1-b}$, $Zn_aBe_{1-a}S_bSe_{1-b}$, $Al_cGa_{1-c}N$, ZnMgBeSe, AlInN stacked on the layer comprising of nanotips;

a layer comprising of cladded quantum dots;

a wide gap semiconductors layer selected from the group of semiconductors consisting of: $Zn_aMg_{1-a}Se$, $Zn_aMg_{1-a}S$, $Zn_aMg_{1-a}S_bSe_{1-b}$, $Zn_aBe_{1-a}S_bSe_{1-b}$, $Al_cGa_{1-c}N$, ZnMgBeSe, AlInN; and

a layer forming contact electrodes, wherein aid set of electrodes are appropriately biased and addressed to create a two-dimensional display.

Claim 27. The EL device as described in claim 1, wherein the electrodes at the bottom of the device are separated by reverse biased junctions.